



# Leading by Example:

## An Action Plan for Green Buildings in Massachusetts State Construction Projects



Final Report  
of the  
Massachusetts  
Sustainable  
Design  
Roundtable

October 2006

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**On the cover (clockwise from top left):** The MATCH School (Boston, MA), Cape Cod Community College, Lyndon P. Lorusso Applied Technology Center (West Barnstable, MA), State House (Boston, MA), Artists for Humanity EpiCenter (Boston, MA)

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DCAM

Division of Capital Asset Management

October, 2006

Dear State Agency and Building Professionals in Massachusetts:

On behalf of the Massachusetts Sustainable Design Roundtable, we are pleased to present to you this *Action Plan for Green Building in Massachusetts State Construction Projects*. This report is the result of an 18-month public-private collaboration of 54 government agencies, private firms, and non-profit organizations that are involved in the funding, oversight, design, and construction of state building projects.

The Action Plan provides practical recommendations that will lead to state buildings that are more efficient, healthier, cost less to operate and maintain, and contribute to the conservation of local, regional, and global natural resources. When implemented, these recommendations will also help keep Massachusetts competitive by promoting innovative technology development, facilitating local university research and testing, and demonstrating to businesses the fiscal benefits of building green.

As co-chairs of the Roundtable, we want to acknowledge the contributions of over 70 agency and private sector staff, many of whom volunteered many hours to reach consensus on some of the key ingredients of a successful green building program. By taking a leadership role in its own buildings, the Commonwealth can demonstrate the clear long-term environmental, health, and fiscal benefits that result from incorporating sustainability principles into our construction programs.

In the end, we believe that building green in the Commonwealth's public buildings is a win-win for our budget, the taxpayer, our environment, and for everyone who visits, works, and lives in a state building. We are excited about moving forward with our green building efforts and look forward to working with all of you in adopting and implementing the Roundtable's recommendations.

Sincerely,

Robert W. Golledge, Jr., Secretary  
Executive Office of Environmental Affairs

David B. Perini, Commissioner  
Division of Capital Asset Management

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## Table of Contents

Executive Summary .....	2
Acknowledgements.....	7
The Business Case for Green Buildings .....	8
The Foundation for Green Building Leadership in Massachusetts .....	16
Recommended Actions .....	24
Additional Information .....	38

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# Executive Summary



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**On the section cover (clockwise from top):** Whitman-Hanson (MA) Regional High School,  
Genzyme Center (Cambridge, MA), ManuLife Financial (Boston, MA)

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## Executive Summary

The Massachusetts Sustainable Design Roundtable (the "Roundtable") is a voluntary, public-private partnership of more than 70 high-level professionals involved in the design and construction of Commonwealth buildings. Under the coordinated direction of the Executive Office of Environmental Affairs (EOEA) and the Division of Capital Asset Management (DCAM), and funded by the Massachusetts Technology Collaborative (MTC), the Roundtable convened in January 2005 with a mission to:

- ***Foster and promote dialogue*** about green building issues among public and private design and construction professionals and other experts
- ***Examine key barriers*** to sustainable design and construction and ***develop consensus*** recommendations on how to overcome these barriers
- ***Promote widespread incorporation*** of sustainable design practices and technologies into all state government construction

This report represents the result of 18 months of Roundtable research, analysis, and deliberation. We are presenting a set of six recommended actions that the Commonwealth can and should implement to make green buildings the standard in public construction.

### A strong business case . . .

Across the country, initial experience with both public- and private-sector buildings that incorporate sustainable design principles is demonstrating that operating cost savings provided by green buildings are considerably greater than any additional upfront or "first" costs. First cost premiums, if present, generally do not exceed four percent and commonly have simple payback periods of as little as three or four years. We note in particular:

- One of the most comprehensive studies of green buildings to date reported that an average cost premium of \$3-5 per square foot produced direct operational savings of approximately \$15 per square foot over 20 years.

#### A NOTE ON TERMINOLOGY

A number of adjectives -- green, sustainable, high performance -- are used interchangeably to describe design and construction practices that explicitly consider site selection, waste minimization, energy efficiency, water conservation, indoor environmental quality, and other environmental and health factors. In this report, the Roundtable primarily uses the term "green building" since it is commonly recognized and can be defined, as it is here, to capture the full range of financial, environmental, and occupant health and productivity benefits that buildings of this kind provide.

- A recent study of efforts to green Massachusetts public schools documented similar results: an average cost premium of 3 to 4 percent returning direct savings 6 to 8 times larger.
- Although the most advanced green buildings have been operational for only a short period of time, initial evidence of their improved performance is highly compelling, most notably energy cost savings of at least 20 and up to 50 percent compared to baseline.

At a time when energy costs are high and getting higher, the ability to reduce energy consumption and gain significant financial savings is perhaps the single most significant benefit that green buildings provide. Green buildings also help to protect and conserve our water resources, provide a market for recycled and environmentally preferable products, and provide substantially improved working and learning environments for building occupants, all of which translate directly or indirectly into cost savings.

And yet cost savings are just one dimension of a business case that also includes the potential for green buildings to serve as a catalyst for economic growth and enhanced competitiveness. Promoting and constructing green buildings can produce benefits across multiple sectors of the Massachusetts economy, from the growth of business that provide related products and services to the enhancement of local university initiatives focused on energy and environmental issues.

Together, these outcomes will contribute to an atmosphere of environmental responsibility and cost-effectiveness that will not only serve to retain existing businesses and residents, but also help to make Massachusetts an even more desirable destination for new or relocating businesses, workers, residents, and students.

## **. . . and a strong foundation for action**

The elements are in place for Massachusetts to join the ranks of green building leaders like California, Minnesota, New York, and Pennsylvania.

- Through a handful of projects, the state's major construction agencies are beginning to demonstrate that green buildings are both smart and feasible.
- Green building experience is taking root through the efforts of forward-thinking cities, towns, private sector companies, non-profit institutions, and private colleges and universities.
- In recent years, Massachusetts has moved aggressively to develop statewide energy and environmental policies that are natural partners for the promotion of green buildings.

But much more work can and should be done. As a major driver of construction activity in Massachusetts, state government can lead by example to ensure that the Commonwealth realizes the full benefit of greener construction.

The Roundtable is pleased to offer the following recommended actions as the first steps toward achieving this goal.

## **SUMMARY OF RECOMMENDED ACTIONS**

### **I. Setting Minimum Standards**

1. Adopt minimum green building standards for all new construction and major renovation projects overseen by designated state agencies.

### **II. Improving the Budgeting, Design and Construction Process**

2. Ensure that long-term operating costs are taken into account when developing project capital budgets.
3. Adopt an integrated design and construction process that ensures incorporation of sustainable design elements throughout the building project.
4. Review existing agency policies, procedures, and regulations to eliminate barriers to and identify opportunities for promoting green buildings.

### **III. Education and Training**

5. Support education and training of key design and construction personnel and a broad outreach program through partnerships with academic institutions, utilities, professional associations, and other sources of expertise.
6. Facilitate awareness of and access to grants, loans, and other green building financial and/or technical assistance that are or may become available.

## Acknowledgements

The Roundtable wishes to acknowledge the following individuals for their work to support the Roundtable and its mission:

The Massachusetts Technology Collaborative Renewable Energy Trust for funding and participating in the Roundtable process.

Sandra Grund, Alissa Bilfield, and Joanne Telegen for their comprehensive research on state sustainable design and construction policies and programs, and critical assistance during Roundtable and working group meetings.

Marie Zack Nolan, Sustainable Design Research Coordinator for effectively and efficiently managing the Roundtable process.

Eric Friedman, EOEa and John DiModica, DCAM for their leadership and dedication as co-chairs of the Roundtable.

The Sustainable Design Roundtable Steering Committee for their expertise, guidance and support:

Barbra Batshalom, The Green Roundtable\*  
Keith Beasley, Massachusetts Port Authority\*  
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Laura Wernick, HMFH Architects\*

\* Also served as a co-chair of a working group.

A full list of Roundtable members can be found on page 42 of this report.

Contractual support for this report was provided by John Weiss and Angela Vitulli at Industrial Economics, Inc.

We would like to thank the Gilbane Building Company for underwriting the printing of this report.

Printed on recycled paper.

# The Business Case for Green Buildings



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**On the section cover (clockwise from top left):** Michael E. Capuano Early Childhood Development Center (Somerville, MA), The Trustees of Reservations, Doyle Conservation Center -- exterior and interior (Leominster, MA), Cambridge City Hall Annex (Cambridge, MA)

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## The Business Case for Green Buildings

Buildings have a significant impact on the environment. Consider that:

- According to the federal Energy Information Administration (EIA), buildings in the United States account for 40 percent of total energy consumption and more than 70 percent of total electricity consumption.
- As a result of this energy use, buildings account for nearly 40 percent of total U.S. carbon dioxide emissions as well as significant shares of U.S. emissions of NO<sub>x</sub> and SO<sub>2</sub>.
- According to U.S. Geological Survey data, buildings consume more than 12 percent of our fresh water supplies.
- As a result of construction, buildings generate 25 percent of all solid waste in the United States.

Based on the fact that buildings have lifetimes that span many decades, the way in which we design and construct our buildings has a direct and very significant bearing on our ability to protect human health and the environment, not only for today's population but for future generations as well.

Buildings also have a significant impact on our budgets. The Commonwealth already commits more than one billion dollars of public money each year to building construction and renovation projects. The state constructs a range of buildings for a variety of uses, from schools, hospitals, offices and courthouses to colleges, prisons, park facilities and affordable housing. The table below represents the estimated value of state agency new construction and major renovation projects each year.

## COMMONWEALTH AGENCIES' INVESTMENTS IN BUILDINGS

Agency	Average Annual Construction Expenditures (millions)
Massachusetts School Building Authority (MSBA)	\$500
Division of Capital Asset Management (DCAM)	\$213
Massachusetts Port Authority (Massport)*	\$125
Massachusetts State College Building Authority (MSCBA)	\$79
Massachusetts Bay Transportation Agency (MBTA)*	\$150
UMass Building Authority (UMBA)	\$50
Department of Housing and Community Development (DHCD)	\$34
Department of Conservation and Recreation (DCR)	\$30
<b>Total</b>	<b>\$1.08 billion</b>

\* Includes private development on state authority land.

## Green buildings pay for themselves . . . and more

Few would argue, as a matter of principle, that greening the Commonwealth's building projects is a bad idea. At the same time, a common belief persists that green buildings cost a lot (or at least more than what the cost of the "non-green" version of the same building would be). As a result, some would argue that making green buildings the standard for all projects in which the Commonwealth is involved is something that we cannot afford to do given the many important demands on scarce financial resources.

The reality is, the Commonwealth cannot afford *not* to take this step.

- Buildings constructed using cutting-edge green design principles are generally still in the early stages of their lifetimes, but experience to date -- in both the public and private sectors -- is already generating compelling evidence that operating cost savings provided by green buildings are considerably greater than any additional upfront or "first" costs. And in some cases there are no additional first costs.
- When green building projects do require an increase in first costs, the increase is typically on the order of 0 to 4 percent. Increases in first costs are generally for features or



systems that maximize long-term cost savings, such as optimized energy systems, daylighting design elements, water-saving fixtures and systems, and continuous air quality monitoring systems.

- The magnitude of additional first costs continues to decline as green building design and construction becomes a standard practice.

In fact, many building projects have achieved green building design and construction objectives *within or for an amount less than the project's original budget*.

An integrated design process can be critical to minimizing any additional up-front costs related to innovative products, processes, or technologies. For example, taking advantage of the energy reductions resulting from enhanced southern exposure, installation of energy efficient windows, and incorporating daylighting might result in the need for a smaller HVAC system, offsetting any up-front costs for these design features. Without taking all these elements into account early in the process, however, an engineer might specify a larger, more expensive HVAC system than is necessary.

In cases where certain technologies and products do cost more, one of the biggest hurdles to the adoption of green building practices is the budgetary practice of considering first costs independent of total costs. While buildings may be expensive to construct, they are even more expensive to operate and maintain over their lifetimes. Federal Government reports indicate that first costs typically account for less than 10 percent of total building ownership costs while up to 85 percent goes to operations and maintenance. Simply put, given that buildings are built to last more than 20 years, and often last decades more, it is fiscally prudent to analyze design

## THE FINANCIAL BENEFITS OF GREEN BUILDINGS

The most recent research into the financial implications of green buildings provides a consistent and compelling conclusion: the magnitude of additional first costs, if any are required, is small and is far outweighed by direct financial benefits.

- A study of 33 buildings across the country that were designed and constructed to "green" standards found that an average first cost premium of \$3-5 per square foot delivered direct financial benefits (resulting from lower energy, water, and other operations and maintenance costs) of approximately \$15 per square foot. (Kats 2003)
- A study that compared 45 buildings designed to meet LEED® certification requirements with 93 buildings that did not have this design objective found no significant difference in construction costs. (Matthiessen and Morris 2004)
- A study of the incremental costs and benefits of green schools in Massachusetts found that financial savings outweigh the 3-4 percent first cost premium by an average of 6-8 times -- and that existing incentives cover, on average, more than 75 percent of the first cost premium. (HMFH 2005)

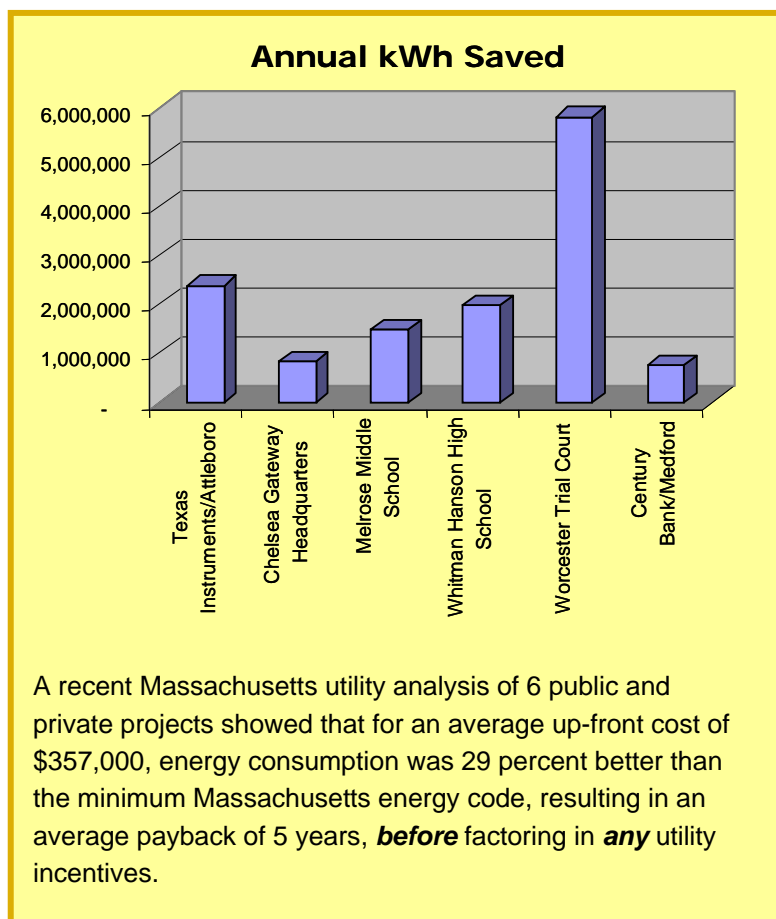
*Note: These studies and other reports are referenced in the Additional Information section of this report.*

alternatives on options beyond those that just consider first costs. When a project is based on total costs, a green building usually becomes the preferred alternative, even when first cost increases are not offset entirely or in large part by utility rebates or other incentives.

The benefits of green buildings are measured in direct operational cost savings as well as in a wide range of indirect effects that generate additional, though perhaps less easily quantified, savings. The most important fact to note with regard to direct cost savings is that the payback period for any green design element is almost always a small fraction of a building's lifetime, usually within 5 to 8 years. On a straightforward financial basis, green buildings frequently pay for themselves quickly, making it easy to justify most additional first costs.

→ **Lower energy costs**

Perhaps the single most significant benefit of a green building is the ability to reduce energy use. Projects that used an integrated approach to energy efficiency from the earliest planning stages have consistently achieved annual cost savings of 20 to 30 percent and in some cases as high as 50 percent. At a time when energy prices are rising, such cost savings simply cannot be ignored. The fact that they can be achieved essentially risk-free (i.e., without adopting new or unproven technologies) makes the decision to adopt a green design that much easier. And by reducing energy use, green buildings make an important contribution to the goal of reducing harmful emissions to the atmosphere.





### **Green Buildings Reduce Water Use**

As part of the Green Schools program, the Whitman-Hanson Regional High School installed a stormwater recycling system that collects rainwater from the roof, and funnels it to a 20,000 gallon storage tank to use for sewage conveyance. The school is saving over 600,000 gallons of water per year.

#### → ***Lower water costs***

In its 2004 Water Policy for the Commonwealth, the Executive Office of Environmental Affairs acknowledged that "current utilization patterns of the Commonwealth's water resources are frequently not sustainable." Improving the performance of our public buildings is one way to help address this problem. As with energy, green building practices can easily reduce water use with readily available, proven technologies and systems. Typical water and wastewater cost savings in green buildings are on the order of 20 to 40 percent.

#### → ***Lower material costs***

Green buildings offer numerous opportunities to use materials that reduce environmental impacts -- and they often have lower lifetime costs. Materials reuse and the use of recycled materials have long been a core element of environmentally preferable practices. From concrete made in part from fly ash to recycled insulation materials, aggressive use of these materials can lead to meaningful reductions in lifetime costs.

#### → ***Substantial indirect benefits***

The Commonwealth's economic vitality is a function of our people, including current members of the labor force and future members receiving an education through the state's education system. We make a significant investment in our workers and students and we should do everything possible to maximize the return on this investment. Evidence to-date of the advantages that green buildings bring to working and learning environments is compelling. By improving the quality of indoor environments (air quality, temperature, lighting, etc.), it appears highly likely that:

- Worker productivity increases
- Health care costs and worker absenteeism decline
- Student performance improves

In general, the value of "healthy" buildings should not be discounted even if it is difficult to quantify. In an increasingly competitive labor market, the comfort of the working environment is an important attribute in attracting and retaining the best personnel.

## Green buildings promote job creation and economic competitiveness

The direct financial benefits of green buildings are justification enough to make green building practices standard in Massachusetts government projects. But the Roundtable believes that this is only one dimension of a business case that includes the potential for green buildings to serve as a catalyst for state economic growth and as a way to help make Massachusetts even more competitive in attracting and retaining businesses and people.

By promoting green building standards in its own construction projects, the state can stimulate a range of economically beneficial outcomes.

- By lowering its own operating costs, the state is reducing the burden on the taxpayer.
- By promoting and constructing green buildings, the state supports innovative Massachusetts companies that make products or provide services that result in lower energy or environmental impacts.
- By adopting a green building policy, the state sends a strong signal to local universities, who are already elevating energy and environmental issues on their research agendas, that the state will be a partner in attracting both students and research dollars.
- By providing leadership and demonstrating the effectiveness of green buildings, the Commonwealth can, in turn, encourage businesses to reduce operating costs and remain competitive.

Together, these outcomes will contribute to an atmosphere of environmental responsibility and cost-effectiveness that will not only serve to retain existing businesses and residents but also help to make Massachusetts an even more desirable destination for new or relocating businesses, workers, residents, and students.

### Green Buildings Will Reduce the Commonwealth's Energy Bill

The Commonwealth's energy bill has reached \$150 million, with most of this cost for heat and electricity in public buildings. Even with milder than expected temperatures, the winter of 2005-2006 saw significant increases in the cost of energy, with heating energy costs rising 10-15 percent in the Northeast. With energy prices unlikely to reverse their upward trend in the foreseeable future, green buildings provide an important and effective means to significantly reduce energy use and costs.

In a recent green schools project, for an additional capital cost of \$316,160 (after utility incentives), the Blackstone Valley Regional Vocational Technical High School is saving \$140,026 per year in lower energy costs.

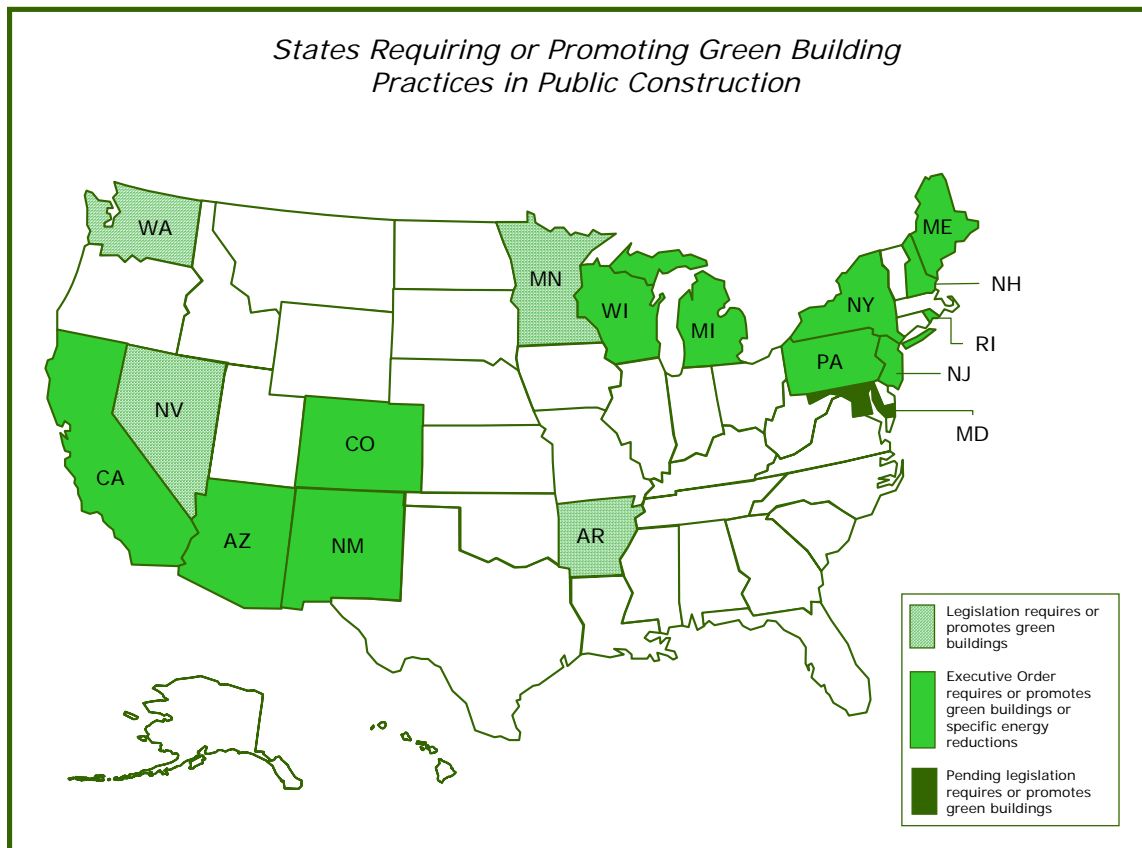
# The Foundation for Green Building Leadership in Massachusetts



## The Foundation for Green Building Leadership in Massachusetts

The feasibility and wisdom of green buildings is gaining national recognition, particularly in the public sector. At the federal level, nearly all of the Cabinet-level departments, as well as several independent agencies, are parties to a Memorandum of Understanding that commits them to "implementation of common strategies for planning, acquiring, siting, designing, building, operating, and maintaining High Performance and Sustainable Buildings." In addition, the General Services Administration, the government's largest property manager, adopted a policy requiring all of their new building projects to meet LEED certification criteria. (LEED® stands for Leadership in Energy and Environmental Design, a consensus-based green building rating system developed and maintained by the U.S. Green Building Council).

At least 17 states (as well as dozens of cities and towns across the country) are home to formal initiatives to promote green building practices in the public sector. In each of these states, leaders have come to the realization that it does not make financial or environmental sense to forego green building-derived benefits.



At the forefront of the movement toward greener public buildings are states like California, Minnesota, Pennsylvania, and New York, where the commitment of key staff combined with efforts to educate state personnel about the benefits of green buildings have produced measurable results. But there is room for additional leadership. Even the most active states have not yet reached the point where green buildings are business as usual.

Massachusetts has the potential to join the ranks of green building leaders.

- Through a handful of projects, the state's major construction agencies -- including the Division of Capital Asset Management (DCAM), the Massachusetts Port Authority (Massport), and the Massachusetts School Building Authority -- are beginning to demonstrate that green buildings are both smart and feasible.
- Green building experience is taking root through the efforts of forward-thinking Massachusetts cities, towns, private companies, non-profit institutions, and colleges and universities. Their efforts are supported by Massachusetts' vibrant community of planning, design, and construction professionals, whose green building knowledge and skills make them national leaders in this arena, as well as by Massachusetts companies that are on the cutting edge of technological innovation.
- In recent years, Massachusetts has moved aggressively to develop statewide energy and environmental policies that are natural partners for the promotion of green buildings.

But much more work can and should be done. While Massachusetts is currently home to 18 LEED certified green buildings, as well as approximately 108 projects that are seeking LEED certification, they are almost exclusively in the private, education, and non-profit sectors. As a major driver of construction activity in Massachusetts, state government can lead by example, ensuring that the Commonwealth realizes the full benefit of greener construction.

## Public agencies are learning how to green their building projects

Publicly-led green building projects are growing in number and are producing exciting results.

- DCAM has adopted **sustainable design guidelines** for their construction and renovation projects, and provides a Conservation Team to advise agency staff and consulting design teams on green materials, designs, and technologies appropriate for specific construction projects. **Cape Cod Community College** is the most recent example of DCAM's guidelines at work. Building on a decade of campus greening



Sunshade at the new CCCC Technology Center reduces glare and heat gain.



initiatives, CCCC broke ground in 2004 on the first new building erected since the campus opened in 1970. The now completed Lyndon P. Lorusso Applied Technology Center, home of the school's Environmental Technology Program, is striving for a LEED Gold rating. Key features include a grey-water recycling system, solar roof panels, energy efficient windows, advanced lighting control systems, and the use of recycled building materials. The Center is projected to use 35 percent less energy per year compared to the performance it would have achieved had it been built strictly to the energy code, with a payback period of five to seven years for both energy and water efficiency investments.

- In 2001, prior to the establishment of the Massachusetts School Building Authority, the Massachusetts Department of Education (DOE) and the Massachusetts Technology Collaborative (MTC) launched the **Green Schools Initiative** to test green building standards, including incorporation of renewable energy technologies, on 18 public school construction projects. Results of this initiative have already been impressive -- energy use reductions averaging 30 percent better than code-compliant buildings with some schools reaching 40 percent. Average avoided energy costs for the "green" schools are \$70,000 per year. The **Whitman-Hanson Regional High School** is one of the Green Schools Initiative projects; it features a solar electric system mounted on the gymnasium roof, a storm water recycling system, improved energy efficiency of the building's envelope and mechanical systems, and improved daylighting designs. As part of the Initiative, DOE and MTC developed the Massachusetts High Performance Green School Guidelines (also known as Mass. CHPS – See Recommendation #1), which provide a clear roadmap for all future school construction projects.



Energy efficient fixtures and day lighting at the Whitman-Hanson Regional High School, a Green Schools demonstration project. Estimated energy savings: \$100,000/year.



- As one of the largest landholders among state agencies, Massport has supported green building practices for its own projects as well as for projects on land the agency leases for private development. For example, the new **Terminal A at Logan Airport** utilized locally-manufactured and recycled materials, natural lighting techniques, energy efficiency practices, and alternative fuel sources. Seventy-five percent of Terminal A's construction and demolition waste was reused or recycled. The **Manulife Financial** corporate headquarters, located on land owned and leased by Massport, is also seeking LEED certification. The project addresses smart growth concerns (e.g., proximity to public transit), incorporates high-efficiency heating and ventilation systems, a triple glazed building envelope, and a roof garden that reduces storm water runoff as well as the building's summer cooling needs.



Logan Airport's new Terminal A is anticipated to be the nation's first LEED-certified airport terminal.

- As part of its sustainability mission, the **Massachusetts State College Building Authority** and **Salem State College** recently completed a 442-bed student dormitory facility. Construction of the student village occurred on a brownfield site, reclaiming three acres of impervious surface and thereby reducing runoff and improving groundwater recharge. Notable green project elements include daylighting in student suites and common rooms, and utilization of recycled content furnishings and finishes.

## Green building practices are beginning to take root throughout the Commonwealth

Green building projects that complement state efforts are also underway in Massachusetts cities and towns as well as in the non-profit and private sectors.

- Under the leadership of Mayor Thomas Menino, the **City of Boston's Green Building Task Force** produced a policy roadmap that places Boston firmly among the nation's green building leaders. The City is committed to achieving the LEED Silver standard in all City-owned building projects, and requiring that all large building projects in Boston are LEED certifiable. In **Cambridge**, renovation and reconstruction of the historic City Hall annex, which included energy efficient windows, “energy smart” lighting systems,

ground source heat pumps, demand control ventilation strategies, and solar panels on the roof, demonstrated that city's commitment to green building practices. With these improvements, Cambridge expects to reduce annual energy consumption in City Hall by almost 50 percent. Other cities and towns, including Arlington, Barnstable, Medford, Newton, Northampton, and Somerville, are following suit with their own plans to achieve greater energy efficiency in public buildings.

- Several leaders in the **non-profit sector** have embraced green buildings as part of their mission to contribute to technological innovation, environmental sustainability, and the public good. Universities in particular have embraced sustainable building as a prong of increasingly popular green campus initiatives; Harvard University, Massachusetts Institute of Technology, Emerson College, and Mount Holyoke College are just a sampling of Massachusetts academic institutions that have undertaken green building projects. Local conservation organizations (Conservation Law Foundation, Trustees of Reservations, New England Wildlife Center), museums (Boston's Children Museum), and the health care sector (Beverly, Massachusetts General, Brigham and Women's Hospitals, among others) have also completed or initiated green building projects.

- Massachusetts boasts a large number of **private sector** green building projects, most notably the twelve-story corporate headquarters of Genzyme, which received a LEED Platinum rating for its innovative design. A good portion of the building's exterior envelope is a ventilation system that blocks the sun in the summer and captures it in the winter, significantly reducing energy needs. Genzyme also



The Harvard School of Public Health's Landmark Center build-out is pursuing LEED certification. Green features help reduce water usage by 20 percent and power usage for lighting by 40 percent. In addition, Harvard will purchase wind power-based renewable energy certificates equal to 50 percent of the space's electricity needs.

reduced water use by 32 percent, and made extensive use of environmentally preferable building materials such as sustainably harvested wood. Other local business leaders that have invested in green buildings include Manulife, Raytheon, Shaw's Supermarkets, and InterGen.

## Green buildings are natural partners for the Commonwealth's energy and environmental initiatives

Massachusetts is a leader in promoting energy efficiency and renewable energy, conserving natural resources through water conservation and material recycling and reuse, and reducing greenhouse gas emissions and the potential impacts of climate change. Green buildings provide benefits that directly support all of these policy initiatives.

- Deciding *where* to put a new building can be as important to the environment and our health as deciding *how* to build it. According to a 2003 Massachusetts Audubon Society report, the Commonwealth loses open space at a rate of 40 acres per day. Development that occurs at a greater distance from urban centers requires expensive new roads and utility line extensions, and degrades air quality due to increases in traffic volumes and the length of daily commutes. The Commonwealth's **smart growth policies** and incentives, such as the \$500+ million awarded annually through the Commonwealth Capital Policy, are integral to reversing this trend. Building green is consistent with the long-range environmental protection and resource conservation goals of smart growth and both should be considered when planning and designing a project.
- In 2004, the Commonwealth released a **Climate Protection Plan** that sets short and medium-term targets for reducing greenhouse gas emissions. Among its recommended actions, the plan specifically identifies green building practices as an important tool.
- In 2002, Executive Order No. 438 led to the development of the **State Sustainability Program** to track and reduce the environmental impacts of state operations through initiatives such as energy and water conservation and the use of recycled and environmentally preferable materials. Green building practices are a key strategy that agencies can use to meet their environmental targets.
- The 2005 **Heating Energy Assistance and Tax Relief (H.E.A.T) legislation** addresses rising energy costs using multiple approaches, including low income assistance and tax credits to individuals and corporations who invest in energy and water efficiency upgrades. In recognition of the contribution green buildings can make to the achievement of energy security goals, the H.E.A.T bill directs DCAM and MTC to develop a plan for integrating renewable energy and sustainable design into construction of buildings owned and leased by the state. A comprehensive green building program as outlined in this document squarely addresses the statute's requirements.

- Massachusetts utilities have long-standing, state-mandated programs to provide **energy efficiency incentives** for construction projects utilizing efficient design and construction. Incentives are available that cover up to 90 percent of the cost difference between conventional and efficient designs, and up to 75 percent of the cost of energy efficient equipment and systems. These programs, which have greatly benefited Massachusetts projects, dramatically help reduce the incremental capital costs of green buildings.
- The Massachusetts **Renewable Portfolio Standard** mandates that electricity providers generate an increasing percentage of power from renewable sources. Green building projects that incorporate on-site electricity generation from renewable sources can help utilities meet these obligations.
- Adopted in 2004, the **State Water Policy** promotes many on-site solutions to water conservation, including grey water reclamation, storm water best management practices, water conserving green building standards, and smart growth siting of new construction projects.
- Since the mid-1990s, the **Environmentally Preferable Product Purchasing Program** has assisted state agencies, municipalities, authorities, and other political subdivisions in buying environmentally preferable products through product testing, specifications development, and bulk purchasing. The program enables all public entities in Massachusetts to purchase proven green building products at a fair price under state contracts.
- The **Solid Waste Master Plan** construction and demolition waste bans mandate reuse or recycling of asphalt pavement, brick, concrete, metal, and wood waste generated by construction projects as of July 1, 2006. Construction site recycling is a key component of green building practices that is specifically recognized under the LEED rating system.

Massachusetts has a solid foundation of green building-related experience, expertise, and policies to support a comprehensive green building program and emerge as a public sector leader within this growing industry. A purposeful and coordinated program promises to result in a whole that is greater than the sum of these parts. In the next section, we present a set of recommended actions for realizing this vision.



# Recommended Actions



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**On the section cover (clockwise from top left):** Salem State College Residence Hall (Salem, MA), Massachusetts Transportation Building (Boston, MA), UMass-Boston Campus Center (Boston, MA), Maverick Gardens (East Boston, MA)

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## SUMMARY OF RECOMMENDED ACTIONS

### **I. Setting Minimum Standards**

1. Adopt minimum green building standards for all new construction and major renovation projects overseen by designated state agencies.

### **II. Improving the Budgeting, Design and Construction Process**

2. Ensure that long-term operating costs are taken into account when developing project capital budgets.
3. Adopt an integrated design and construction process that ensures incorporation of sustainable design elements throughout the building project.
4. Review existing agency policies, procedures, and regulations to eliminate barriers to and identify opportunities for promoting green buildings.

### **III. Education and Training**

5. Support education and training of key design and construction personnel and a broad outreach program through partnerships with academic institutions, utilities, professional associations, and other sources of expertise.
6. Facilitate awareness of and access to grants, loans, and other green building financial and/or technical assistance that are or may become available.

## Recommended Actions

The Commonwealth of Massachusetts Sustainable Design Roundtable is pleased to present the following consensus recommendations as a framework for a new "business as usual" in public construction. By implementing the recommended actions, the Commonwealth will move a long way toward making green design and construction the norm for state government buildings and provide a model for all other construction in the Commonwealth.

The Roundtable's recommended actions fall into three general categories:

- Setting minimum standards
- Improving the budgeting, design, and construction process
- Education and training

Each recommended action is the result of the Roundtable's careful consideration of many potential options for the effective promotion of green buildings within the public sector. In developing these recommended actions, the Roundtable relied on its members' expertise and on their knowledge of what is both reasonable and feasible in Massachusetts. In addition, the Roundtable directed several research studies to inform its work, including analyses of green building efforts and experience to-date within Massachusetts agencies, a survey of Massachusetts design and construction practitioners, and a review of green building initiatives in other states.

While the Roundtable recommends that ultimately all state entities that finance, oversee and/or manage state construction adhere to the recommendations in this section, it recognizes that the initial focus of these actions should be on projects that are designed by a state entity for a public purpose. This would preclude any project constructed for use by the private sector or for individual residents. Where applicable, the following recommendations identify the specific agencies and authorities to which these recommendations should apply. It is the hope of the Roundtable that all state entities will ultimately see the value of green buildings and adopt the following action steps for all projects under their purview.



## I. Setting minimum standards

While recognizing that there may be special circumstances in which meeting certain green building criteria may not be appropriate (e.g. public safety needs), the Roundtable believes that establishing minimum green building standards for all state public construction projects is critical to the development of a successful program of creating high performance state buildings in Massachusetts. The vast majority of states with green building initiatives have set minimum standards for state construction projects as a cornerstone of their efforts. Because of first cost and procedural barriers to green buildings in the public sector, voluntary standards will not be enough to catalyze widespread adoption of better practices. Similar to building structural and safety codes, minimum green building standards are essential for guiding project managers and contracted design and construction professionals toward a commonly understood and meaningful benchmark of performance.

The Roundtable considered several possible standards for Massachusetts, with a focus on the Leadership in Energy and Environmental Design (LEED ®) system, the most widely accepted national green building standard. LEED is a consensus-based green building rating system developed and maintained by the U.S. Green Building Council. To receive a base certification in LEED, a project must have at least 26 out of a possible 69 points in the areas of site selection and development, water and energy efficiency, sustainable materials and resources, indoor environmental quality, and innovation in sustainable design and construction. Silver, gold and platinum are three possible additional ratings based on additional points a project receives. Nearly all practitioners who responded to the Roundtable's survey indicated that they have used LEED previously, while several practitioners noted that the state should adopt or adapt LEED instead of developing new standards.

At least 14 other states make explicit programmatic reference to LEED standards. The Roundtable's research indicates that officials in other states express overall satisfaction with LEED for both ease of implementation, conservation of energy and resources, and protection of the environment and public health. In contrast, experience in developing and implementing unique state standards has been mixed.

At the same time, LEED has several shortcomings. One of the most frequently cited problems with LEED is that although the vast majority of green building projects focus on energy efficiency it is possible for relatively inefficient projects to accrue enough LEED points in non-energy areas to gain certification. Moreover, LEED certification in and of itself is not enough to meet other Commonwealth environmental objectives (water conservation, smart growth, etc.). Thus, the Roundtable is recommending adoption of a new "Massachusetts LEED Plus" standard that specifically mandates certain LEED points for energy performance, building commissioning (i.e. 3<sup>rd</sup> party verification that a building's systems work as designed), achievement of smart growth objectives, and water conservation. To ensure projects meet the energy requirements of

the Massachusetts LEED plus standard, agencies may want to consider taking advantage of the U.S. Environmental Protection Agency's EnergyStar Target Finder system that will help set energy goals and measure projected consumption during the design stage.

For school projects, the Roundtable recommends adoption of a similar but more targeted standard known as Mass CHPS (Collaborative for High Performance Schools, pronounced "chips"). This standard, developed through a collaborative process by the Massachusetts Technology Collaborative and the Massachusetts Department of Education, accounts for issues unique to public school buildings such as:

- school-aged populations
- school occupancy schedules
- student transportation issues
- different uses of landscape (i.e. playing fields and playgrounds)
- stricter low-emitting materials that are more protective of children's health
- acoustics criteria including state-of-the-art standards for background noise in classrooms

### **Recommended Action #1:**

**Adopt minimum green building standards for all new construction and major renovation projects overseen by designated state agencies.**

The Roundtable has developed four specific green building standards for building projects; the applicability of the standards is determined by the constructing entity and project size:

#### **1.1 Large Projects**

All executive agencies shall adhere to the newly created "Massachusetts LEED Plus" standard for projects that are 20,000 square feet or larger and designed for use by a public entity.

Massachusetts LEED Plus requires obtaining the basic LEED certification and attainment of the following specific LEED credits:

- 1.1.1 Energy performance exceeding Massachusetts Energy Code requirements by at least 20 percent (*LEED-NC Version 2.2, Energy & Atmosphere, Credit 1*).
- 1.1.2 Third party building commissioning (*LEED-NC Version 2.2, Energy & Atmosphere, Prerequisite 1, Credit 3*).
- 1.1.3 At least one of the four following Smart Growth criteria (unless the criteria conflict with another critical public policy objective):

- a) Construct or renovate on a previously developed site (*LEED-NC Version 2.2 Sustainable Sites, Credit 2*)
  - In a community with a minimum density of 60,000 square feet per acre **or**
  - Within one-half mile of ten basic services and a residential zone or neighborhood with an average density of ten units per acre; and with pedestrian access between buildings and services.
- b) Construct or renovate on a brownfields site (*LEED-NC Version 2.2, Sustainable Sites, Credit 3*).
- c) Construct or renovate on a site with public transportation (train or bus) within one-half mile (*LEED-NC Version 2.2, Sustainable Sites, Credit 4.1*).
- d) Maintain 75 percent of existing building structure and envelope (*LEED-NC Version 2.2, Materials and Resources, Credit 1.1*).

1.1.4 Two irrigation and building water efficiency criteria:

- a) Reduce potable water consumption for irrigation by 50 percent (*LEED-NC Version 2.2, Water Efficiency, Credit 1.1*).
- b) Incorporate strategies that will conserve 20 percent of building water use (*LEED-NC Version 2.2, Water Efficiency, Credit 3.1*).

## **1.2 Small Projects**

For projects smaller than 20,000 square feet, all executive agencies shall design and construct new buildings and major renovation projects to meet at least one of the following:

- 1.2.1 Adhere to the “Massachusetts LEED Plus” standard described above, or
- 1.2.2 Surpass the Massachusetts Energy Code requirements by at least 20 percent, or
- 1.2.3 Follow the prescriptive approach of the New Buildings Institute's Advanced Buildings Benchmark Tool. (*Benchmark*™ is a flexible system of specific criteria for technologies and practices that provide unique paths to achieving energy-efficient buildings).

## **1.3 School Buildings**

The Massachusetts School Building Authority (MSBA) should adopt, to the greatest extent feasible, minimum building standards contained in the Massachusetts Collaborative for High Performance Schools (Mass CHPS) for new K-12 schools and encourage school districts to attain higher levels of compliance beyond the minimum standards.

## **1.4 Other Building Projects**

All projects involving state entities, including, but not limited to, state authorities, private projects on state land, and those that receive state funding, should strive to meet the standards outlined in 1.1 and 1.2.

## **II. Improving the budgeting, design, and construction process**

Realizing the long-term financial benefits of public sector green buildings will continue to be challenging without a commitment to changing the budgeting, design, and construction processes. Most importantly, construction agencies need to integrate first cost and operating cost considerations into project planning, even if budgeting processes keep capital and operational resources separate.

Given increasing energy and operating costs, and the length of time state buildings are in operation, all state construction projects should work to identify ways to reduce these ongoing costs which can impact the state operating budget for decades. Higher first costs for more efficient products, materials, equipment or technology should not be a barrier to their inclusion.

Also important is the need to employ an integrated design and construction process (as opposed to a system-by-system approach) that will ensure that designers, architects, contractors and others work collectively to develop solutions that focus on sustainability in the project's design. Introducing sustainability concepts and strategies early in the process is the most effective way of maximizing the benefits of sustainable design without adding to the up-front cost. Design decisions should work to integrate the most appropriate mix of design choices that reduce the project's life cycle costs and cost-effectively achieve sustainable design outcomes.

Some practitioners surveyed by the Roundtable as well as Roundtable members themselves indicated that agency regulations, processes and procedures might sometimes be a barrier to green buildings, or at least not encourage their development. While the Roundtable found no egregious examples of such barriers, members did note that rules and regulations surrounding such issues as water reuse and distributed generation may be preventing innovative technology from being incorporated into large numbers of projects. There may also be opportunities for agencies to promote green buildings more effectively. The Massachusetts Environmental Policy Act Office (MEPA) certificates, for example, sometimes encourage project proponents to incorporate low impact development, green building and smart growth elements.

The Roundtable recommends the following actions to catalyze change in the budgeting, design, and construction process.

**Recommended Action #2:**

**Ensure that long-term operating and maintenance costs are taken into account when developing project capital budgets.**

To implement this recommendation, all agencies shall:

- 2.1 Identify green building strategies, materials or technologies that can reduce the long-term operating costs of the building, including but not limited to, energy, water, maintenance, product repair and replacement.
- 2.2 Include in the study and design phase, all identified strategies, materials and technologies if there is a payback of 10 years or less after accounting for incentives, grants, and other incremental funding.
- 2.3 Ensure that initial construction project capital budgets incorporate possible higher first costs for building elements that have paybacks of ten years or less.

**Recommended Action #3:**

**Adopt an integrated design and construction process that ensures incorporation of sustainable design elements throughout the building project.**

To implement this recommendation, all agencies shall:

- 3.1 Ensure an approach to design and construction that includes the participation of all major stakeholders involved in the design, construction, use and operational elements of the building.
- 3.2 Set goals and targets for annual energy and water use, operations and maintenance costs, environmental impacts, resource use, indoor air quality and building performance.
- 3.3 Examine a building and its systems as a whole, rather than component by component. This will enable the team to reduce design and construction costs to the greatest extent possible while maximizing budgetary and environmental gains.

#### **Recommended Action #4:**

**Review existing agencies' policies, procedures and regulations to remove barriers and identify opportunities for promoting green building projects.**

To implement this recommendation, all appropriate agencies shall:

- 4.1 Examine rules, regulations, review processes and funding procedures to identify where barriers exist to sustainable design and construction, and where revised procedures could support more widespread adoption of green building practices.

### **III. Education and Training**

States that are leaders in promoting green building practices cite education, training, and the ready availability of information as critical drivers of program success. A notable example is Pennsylvania, which partnered with design experts at Carnegie Mellon University to present a well-attended and well-received year-long seminar series for state personnel. In the Roundtable's practitioner survey, the lack of education and training opportunities was the second most frequently cited barrier to green buildings in Massachusetts (after the disconnect between first costs and operating costs).

Collaboration with academic institutions has been a key component of green building initiatives across the nation. In addition to Pennsylvania's work with Carnegie Mellon, the State University of New York at Buffalo spearheaded the effort to develop High Performance Building Guidelines, which are designed to become a standard reference for all New York state agencies. The University of Minnesota serves as the repository for, and analyst of, all state green building project performance data, a role also played by the University of California at Berkeley to support that state's green building initiative. Massachusetts is fortunate to have outstanding academic and other institutions that are poised to provide a broad range of technical support services to the Commonwealth's efforts.

The Green Roundtable, Boston Society of Architects, Massachusetts Association of General Contractors, Northeast Energy Efficiency Partnership and Northeast Sustainable Energy Association are examples of leading, local not-for-profit and professional organizations in the sustainable design and construction field that have also been active in the MA Sustainable Design Roundtable process.

The Roundtable also determined, supported by practitioner surveys, that a lack of knowledge about available resources and other possible incentives for green buildings should be addressed to ensure that such resources are adequately understood and effectively utilized. While a range of utility, state and federal incentives exist, most respondents to the Roundtable's practitioner survey indicated that much more could be done to promote their terms and availability. An important goal of the Commonwealth's green building initiative should be to ensure full utilization of all available incentives.

Key incentive programs include:

- Utility incentives for energy efficient design and construction of high performance systems and equipment
- MTC renewable energy funding
- Potential funding from the Massachusetts School Building Authority for public school construction for projects that meet energy and smart growth criteria

Both existing and future opportunities for green building education and training are widespread in Massachusetts. Many non-profit organizations, higher education institutions, and utilities already provide various resources that can be taken advantage of by state agencies. Future training programs and other educational efforts could be developed relatively quickly and simply, given the vast expertise that exists in the state. It is clear that a coordinated green building education and training program would be helpful, given the responses to the barrier survey and the importance placed on these efforts in other locales.

In recognition of the importance of education and training and knowledge of funding sources to the success of a green building initiative, the Roundtable offers the following recommendations.

**Recommended Action #5:**

**Support education and training of key design and construction personnel and a broad outreach program through partnerships with academic institutions, utilities, professional associations, and other sources of expertise.**

To implement this recommendation, the Commonwealth should partner with utilities, higher education, non-profit organizations, and professional associations and others to:

- 5.1 Ensure that key state personnel at both construction agencies and agencies at which buildings will be constructed receive appropriate training on the benefits of green buildings and potential implementation strategies.
- 5.2 Facilitate green building awareness among architects, designers, engineers, tradespeople, developers, and others associated with the design and construction of state buildings.
- 5.3 Offer green building awareness and education to appropriate municipal and local school officials.
- 5.4 Provide general information to the public at large about green buildings, their benefits, activities in Massachusetts, and other related information that will help to promote high performance construction across the Commonwealth.
- 5.5 Research a simple, standard and effective integrated (whole building) life-cycle cost-benefit assessment method for state projects.
- 5.6 Support higher education research and development of new and beneficial green building technologies and practices.



### **Recommended Action #6:**

**Facilitate awareness of and access to grants, loans, and other forms of green building-related financial assistance that are or may become available.**

To implement this recommendation, the Commonwealth should:

- 6.1 Ensure that all agencies are aware of available incentives and are knowledgeable about how to take advantage of them.
- 6.2 Facilitate access to such incentives when they are available.
- 6.3 Identify additional incentive programs that may become available and promote them to the design and construction community.

## **Implementation**

The Roundtable encourages Commonwealth agencies and authorities to move forward with the recommended actions outlined in this Plan as quickly as possible. The Roundtable recommends that all agencies and authorities should immediately adopt minimum green building standards for construction projects that have not yet entered into the design phase. The Roundtable expects that agencies with prior green building experience will initially assume leadership roles in providing guidance and support to other agencies on how to implement these recommendations. Over the longer term, the Roundtable strongly encourages state construction agencies to communicate and collaborate on a regular basis; a key to the success of this initiative will be the development of a shared body of practical knowledge, experience, and best practices.

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# Additional Information



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**On the section cover (clockwise from top left):** Ashland High School (Ashland, MA), Cape Cod Community College, Lyndon P. Lorusso Applied Technology Center (West Barnstable, MA), InterGen (Burlington, MA), Raytheon ETL/SAT Com Building (Marlboro, MA)

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